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A Trial to Establish Technical and Commercial Viability of Cod Frame Mince Recovery

Canpolar Inc.

Fisheries Development Division
Fisheries and Habitat Management
Newfoundland Region
P.O. Box 5667
St. John;s, Newfoundland
A1C 5X1

December 1988

Canadian Industry Report of Fisheries and Aquatic Sciences No. 197

Fisheries and Oceans Pêches et Océans

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By

Canpolar Inc.

For

Fisheries Development Division
Fisheries and Habitat Management
Newfoundland Region
P.O. Box 5667
St. John's, Newfoundland
A1C 5X1

Canpolar Inc., Ashley Building, 31 Peet Street,
St. John's, Newfoundland, A1B 3W8

90-02239/

Minister of Supply and Services Canada 1987

Cat. No. F597-14/ E 197 ISSN 0704-3694

Correct citation for this publication

Canpolar Inc., 1988, A trial to Establish Technical
and Commercial Viability of Cod Frame Mince Recovery.
Can. Ind. Rep. Fish. Aquat. Sci., 197: vii + 25p.

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Note: Copies of appendicies to this report are available from:

Fisheries Development Division
Department of Fisheries and Oceans
P. O. Box 5667
St. John's, Newfoundland
A1C 5X1

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1.0 ABSTRACT

Canpolar Inc. 1988. A Trial to Establish Technical and Commercial Viability of Cod Frame Mince Recovery. Can. Ind. Rep. Fish Aquat. Sci.

An unsolicited proposal was submitted to the Department of Supply and Services by Canpolar in May, 1988 for a trial to establish technical and commercial viability of cod frame mince recovery.

The primary purpose of the MINCE WASHER demonstration program, carried out in Beothic's Valleyfield plant was to evaluate the operation of the machine under plant conditions and to find answers to a number of specific key questions related to the handling of the raw material, the operation of the machine and definition of the fish mince product.

Answers were found to all these questions except for those related to the use of washed mince as feedstock for surimi production. It did not prove practicable for the surimi plant in Clarenville to take mince for this purpose during the period in which the demonstration program was in progress.

The important outcomes of the program were the successful integration of the MINCE WASHER system into Beothic's existing production plant, and winning acceptance by purchasers of Beothic's products, for washed mince mixed with regular v-cut mince.

RÉSUMÉ

Le ministére des Approvisionnements et Services a reçu de Canpolar, en mai 1988, une proposition spontanée d'essai visant a établir la viabilité technique et commerciale de la récupération des résidus restant sur les carcasses de morue.

Le but principal du programme d'essai de la laveuse de résidus, mis en oeuvre à l'usine Beothic de Valleyfield, élait d'évaluer le fonctionnement de cette machine en milieu de production et d'essayer de trouver la résponse à un certain nombre de questions capitales concernant la manutention de la matiére preiére, le fonctionnement de la machine et la détintion du produit obtenu à partir des résidus de poisson.

On a trouvé résponse à toutes ces questions, à l'exception de celles portant sur l'emploi des résidus lavés comme matiére de base pour la fabrication du surimi. Il s'est avèrè que l'usine de surimi de Clarenville n'était pas en mesure d'accepter les résidus pour sa production pendant la durée du programme expérimental.

Le programme a débouché sur des resultats importants, soit l'intégration du système de lavage des résidus à la chaîne de production de l'usine Beothic et l'acceptation, par les acheteurs des produits de l'usine, des résidus lavés mélangés aus résidus habituels provenant de la coupe en v.

2.0 INTRODUCTION

2.1 History

The Canpolar MINCE WASHER technology was proved in principle at a fish plant during the late summer of 1987. The technology has shown the potential to increase the productivity of an Atlantic Region fish plant from 5% to 15% by utilizing mince derived from cod waste as edible portions and for surimi feedstock.

The original proof of the principle prototype was redesigned over the winter of 1987/88. Primary upgrading improved ease of operation/ maintenance, sanitary performance and optimum throughput.

In conjunction with the redesign work, a market study was completed by three Marketing Consulting Groups. The market study was completed by the receptive to the concept of washing mince but they would have to be convinced that a market exists for the washed mince end product. They would also need to be assured that the Canpolar MINCE WASHER is capable of operating consistently in a typical fish plant with little maintenance. The study concluded that the potential market for the MINCE WASHER technology is approximately thirty (30) units in Newfoundland, twenty (20) units in the remainder of the Atlantic Region, and potentially one hundred (100) units in other parts of the world.

A demonstration project that would see the MINCE WASHER integrated into a real fish plant production environment was proposed to provide a demonstration of functional and economic performance.

2.2 Objectives of Program

The demonstration program was undertaken with the following overall objectives:

1. **Technology** - to assess in-plant handling and production methodologies for collar and frame mince products of known quality and value; and

2. to assess the performance of the machine operating on the production line in a fish plant over an extended period.

3. **Market** - to assess the production and market economics for full-scale frame mince recovery materials.

Further detail is set out in the Memorandum of Understanding between Beothic Fish Processors and Canpolar Inc. dated May 4, 1988 (Appendix F).

3.0 MOBILIZATION

Approximately three (3) weeks elapsed from the time the MINCE WASHER arrived in Valleyfield on July 1, 1988, until Canpolar was able to process material on a full production basis. Most of this time was spent designing, fabricating and installing the necessary ancillary equipment to be used with the MINCE WASHER for frame and collar recovery. After the MINCE WASHER itself was hooked up to water and power, an attempt was made (while waiting on conveyors and fluming) to manually recover collars and trimmed frames in order to prepare samples of washed mince. This task was quite cumbersome due to space limitations in the production area. It was decided to wait until the raw material could be recovered more effectively.

3.1 Plant Integration

Frame and collar material must first be recovered mechanically or manually, deboned and then washed with the MINCE WASHER.

Prior to this demonstration program, the MINCE WASHER had been operated only in a batch processing mode. The frames and collars used as raw material would be collected from a fish plant, in 1000 lb. batches and transported to the Marine Institute for processing. It was essential therefore to fully integrate the machine into a real production environment in order to better understand the practical problems associated with materials handling and conveying.

There are many different plant configurations throughout the Island, some of which are automated, some are semi-automated while others are totally manual. Because there were so many unknown factors affecting the integration of the MINCE WASHER into a fish processing operation, it was decided to run the demonstration program into a semi-automated plant. By integrating into a semi-automated plant it would be possible to answer questions concerning labour costs, ancillary equipment costs and location, raw material quality and plant capacity.

It was also necessary to demonstrate the MINCE WASHER concept in a plant that had a steady supply of fish.

3.2 Beothic's Valleyfield Plant

Beothic's Valleyfield plant processes cod with both automated and hand cutting lines. The BAADER 184 filleting machine is used, operated at a maximum throughput of 40 fish/min. This machine comes fully equipped with a frame cutter that trims the kidney below the spinal cord (see Figure 2-1 and Figure 2-2). By trimming the kidney from the frame the quality of the deboned mince can be maximized. An automatic collar

Figure 2-1 Whole Frame

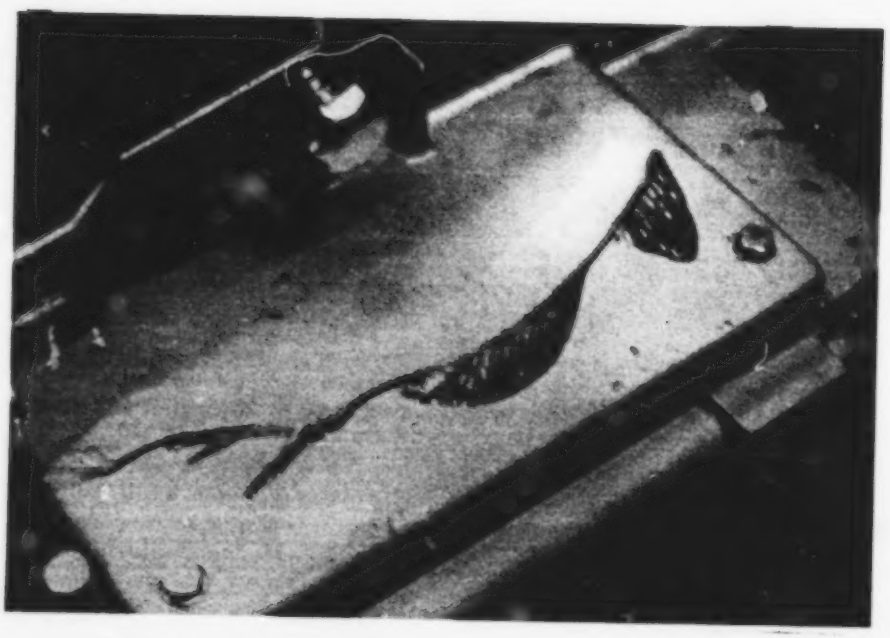


Figure 2-2 Trimmed Frame After Passing Through
BAADER 184 Optional Frame Cutter

cutter is an optional piece of equipment that can be attached to the BAADER 184. However, for this to be effective the collars have to remain on the fish once the heads are removed. Beothic utilizes a BAADER 426 heading machine which leaves the collars attached to the head (see Figure 2-3). Thus a collar is of no use.

An objective of the demonstration program was to integrate the MINCE WASHER into a real production environment so material handling methods could be evaluated. Considerable effort was put into the design and installation of a materials handling system to recover the collar bones and trimmed frames before they were discarded as offal.

Due to the various combinations of raw material that were available (i.e. collars, whole frames and trimmed frames), it was decided to focus on collars and trimmed frames which produce the best quality mince. In order to penetrate the secondary market for minced block it will be necessary to produce a product of exceptional quality. It was felt that samples of whole frame mince and collar mince could be prepared and shipped to Clarenville for surimi feedstock later in the demonstration program.

With collar and trimmed frame recovery being the objective, a contract was let to Collins Aluminum to assist in the design and fabrication of the necessary conveying and fluming equipment.

The following section describes the plant production area, the ancillary equipment used to recover frames and collars, and integration of the MINCE WASHER with both the equipment and the plant:

3.2.1 Plant Layout (BAADER 184 Production Area)

The automated production area at Beothic's Valleyfield plant consists of one BAADER 426 heading machine, one BAADER 184 filleting machine (complete with skinner) and necessary conveying equipment.

A floor plant of the setup is shown in Appendix A, Figure A1 and a photograph of the production area is shown in Figure 2-4. The fish to be processed enters the production area through a conveyor located adjacent to the BAADER heading machine, From there, one operator feeds the fish into the heading machine where the head is cut, with collars attached, and discarded as offal. The headless fish continues towards the BAADER 184 where a second operator feeds it into the filleting machine producing two skinless fillets. The frame is discarded into an offal chute located under the BAADER 184. The skinless fillets are then toted to the hand lines where they are trimmed and candled.

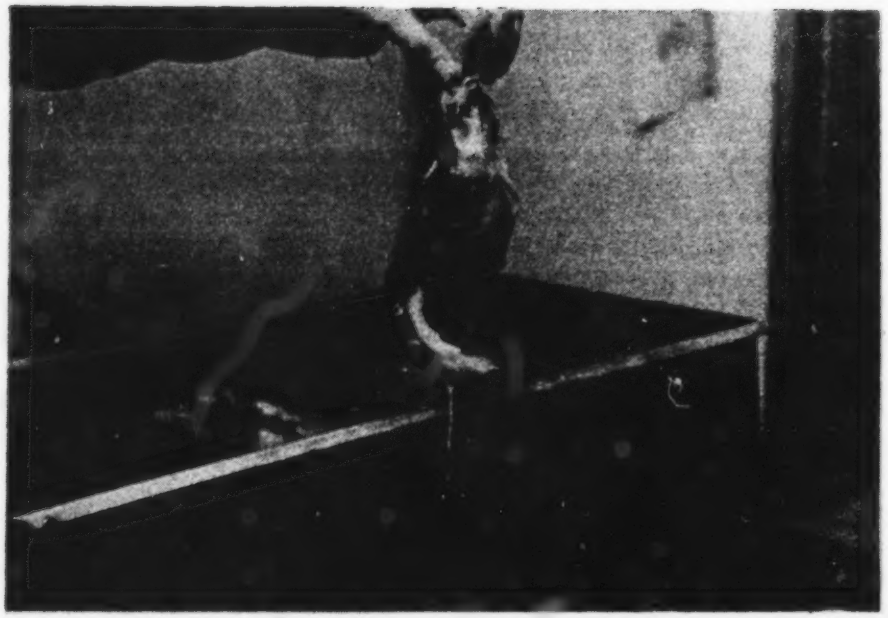


Figure 2-3 Cod Head After Passing Through
BAADER 410 Heading Machine

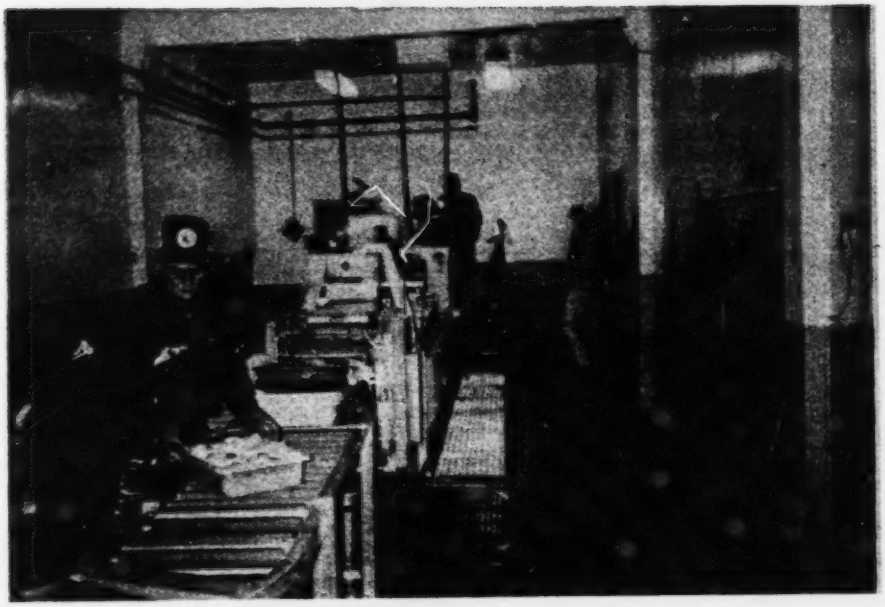


Figure 2-4 Beothic's Valleyfield Plant Automated Production Area Utilizing BAADER 184 Filleting Machine

3.2.2 Capacity

Production of codfish through the BAADER 184 filleting machine at Beothic's Valleyfield plant can range between 25-40,000 lbs., in a nine-hour shift. Assuming a steady supply of both trimmed frames and collar bones is attained, the yield of washed mince from Canpolar's MINCE WASHER totals 2,600 lbs. in nine hours. Figure 2-5 represents the breakdown by weight of the various raw components, based on 45,000 lbs. of head-on gutted fish processed in a nine-hour shift. The yields and production rates were determined at Beothic's plant and a detailed outline of the procedure used in determining this data is given in the following sections of the report:

3.2.3 Ancillary Equipment

As mentioned previously, the focus of attention with respect to raw material was recovery of the trimmed portion of the frame and the collar bones.

Due to the various unknowns prior to this demonstration project, one of the main concerns was not to modify permanently any of Beothic's existing processing equipment or process. The preference was to install the minimum amount of equipment necessary to achieve the objectives while not interfering with Beothic's process.

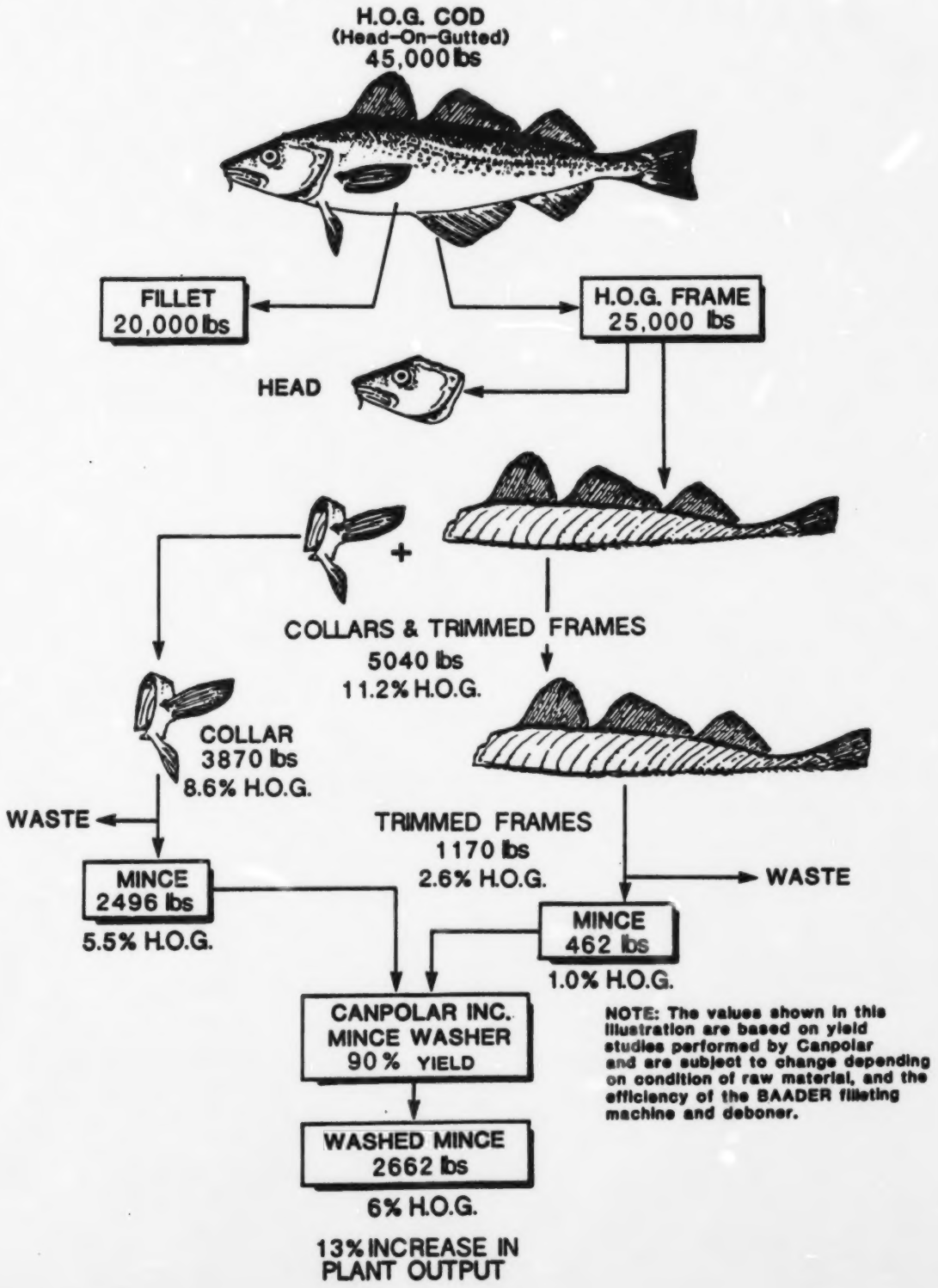
The mince recovery installation for processing collars and trimmed frames is shown in Figure 2-6. The trimmed frames are recovered from the BAADER 184 filleting machine through the use of its frame cutter option. This frame cutter is sold with every BAADER 184 but is usually removed by Newfoundland processors. The trimmed frames are ejected from the frame cutter on either side of the machine and are simply collected in a tote pan and carted to the BAADER 694 mincing machine at approximately 10-15 minute intervals. Refer to Appendix A, Figure A1, A2 and A5 for a schematic representation of this process.

The manual recovery of collars required the installation of a materials handling system that would be efficiently and ergonomically designed to conform to an operator's requirement over a nine-hour shift. The collar recovery process is shown in Figure 2-6 and in Appendix A, Figures 1a, A2, A3 and A4. After the heads are removed from the fish by the BAADER 426 heading machine, the heads, with collars attached, are ejected at the bottom into a flume that descends and eventually ties into the low end of an inclined Intralox belt conveyor. From there the heads are moved along the conveyor upwards towards the collar collection table. As the heads fall from the conveyor onto the conveyor discharge chute the operator has the option to adjust the deflector into one of two positions. The deflector can be set to either divert heads onto the table or into the waste pipe. This is done simply because only one operator is able to process heads at a time due to the limited space within the production area. Realistically, two operators are required to

Figure 2.5

RECOVERY OF MINCE FROM WASTE PORTIONS OF ATLANTIC COD

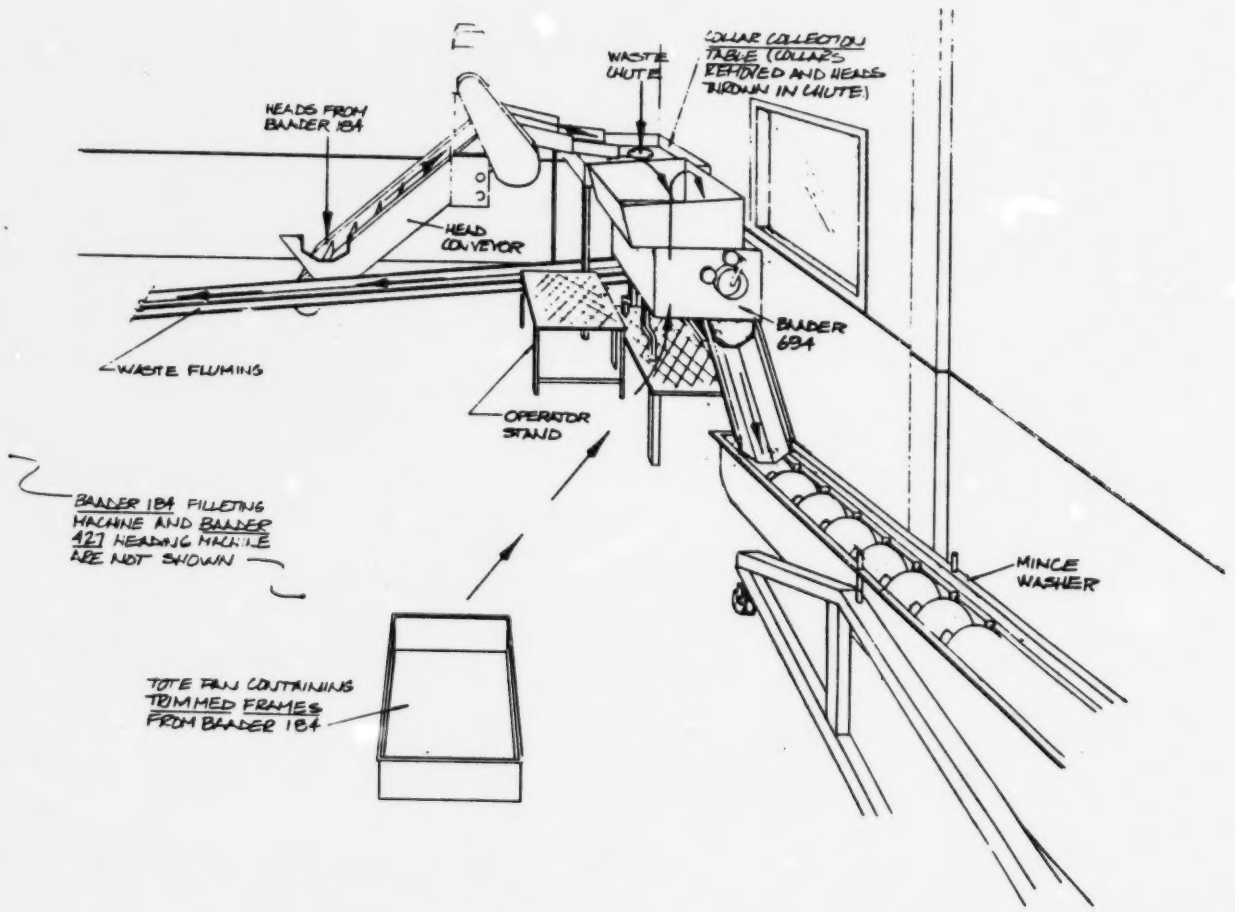
BEOTHIC VALLEY FIELD PLANT 9 HR. SHIFT



NOTE: The values shown in this illustration are based on yield studies performed by Canpolar and are subject to change depending on condition of raw material, and the efficiency of the BAADER filleting machine and deboner.

MINCE WASHER/BEOTHIC PLANT INTEGRATION PLAN PERSPECTIVE

Figure 2.6


WASTE CHUTE
COLLAR COLLECTION TABLE (COLLARS REMOVED AND HEADS THROWN IN CHUTE)
HEADS FROM BAADER 184
HEAD CONVEYOR
BAADER 694
WASTE FLUMING
OPERATOR STAND
BAADER 184 FILLETING MACHINE AND BAADER 427 HEADING MACHINE ARE NOT SHOWN
MINCE WASHER
TOTE PAN CONTAINING TRIMMED FRAMES FROM BAADER 184

DIMENSIONAL TOL:	Canpolar Inc. Ashley Bldg, 31 Pearl St. St. John's, NF	
SURFACE FINISHES:	DRAWN: GB	CHECKED:
MAT'L:	DATE: Oct. 14/88	SCALE: NTS
PART NAME:		PART NO:

recover all the collars that pass through the system. Manipulation of the deflector allows the sole operator to have control over the amount of heads that gather on the collar collection table. As the heads are deflected onto the table the operator waits until a sufficient number have accumulated and then he sets the deflector to divert the heads into the waste pipe. At this point the operator can remove the collars from the heads one by one. As the collars are removed they are tossed into the hopper of the BAADER 694 deboner, which is located to the right of the collar collection table, see Figure 2-7. One operator was required to feed the trimmed frames and collars through the BAADER 694. This person was also responsible for the Mince Washing process. As the mince is ejected from the deboner it falls into a water sluiced chute and is directed into the feed end of the MINCE WASHER (see Figure 2-8).

3.3 MINCE WASHER

The Canpolar MINCE WASHER at Beothic's plant is shown in Figure 2-9 and 2-10, after installation of all necessary conveying and fluming. The amount of work space within the production area was quite limited. However, there were no major conflicts for work space between Beothic's and Canpolar's plant workers. Also note the arrangement of the ancillary equipment and its location with respect to the BAADER 184 filleting machine and Canpolar's MINCE WASHER..

The unwashed mince enters the MINCE WASHER at the low end where it is conveyed upwards along an inclined screw conveyor. The duration of the entire washing process, including drainage, takes approximately 12 minutes of a rotational speed of 1.5 rpm - 8 minutes residence time for washing the mince, (Figure 2-11) and from four (4) minutes for drainage across a perforated section of the screw conveyor housing (Figure 2-12).

The mince is collected by tote pan as it is discharged from the end of the MINCE WASHER and brought to the packing line where it is mixed with v-cut mince and frozen as mince block. The maximum input of the MINCE WASHER is approximately 500 lb./hr. This is compatible with the 630 lb./hr. output of collars and trimmed frames from the BAADER 184 (based on 40m000 lb. H.O.G. cod per nine-hour shift) which, in turn, will yield 300 lb./hr. of mince from the BAADER 694. The output of the BAADER 694 at maximum capacity (1,100 lb./hr. Input) is about 500 lb./hr. of mince, the same as the maximum input of the MINCE WASHER.

The Canpolar MINCE WASHER performance at 1.5 rpm has been satisfactory in terms of washing and drying. However, increasing the rotational speed beyond this point in order to increase the throughput results in a quick build up of particles on the perforated surface of the screw conveyor flights and this eventually causes flooding. When flooding occurs, control over the process is lost and the MINCE WASHER must be momentarily operated in reverse mode to effectively empty the machine of the product and relieve the flooding. The original proof of principle MINCE WASHER

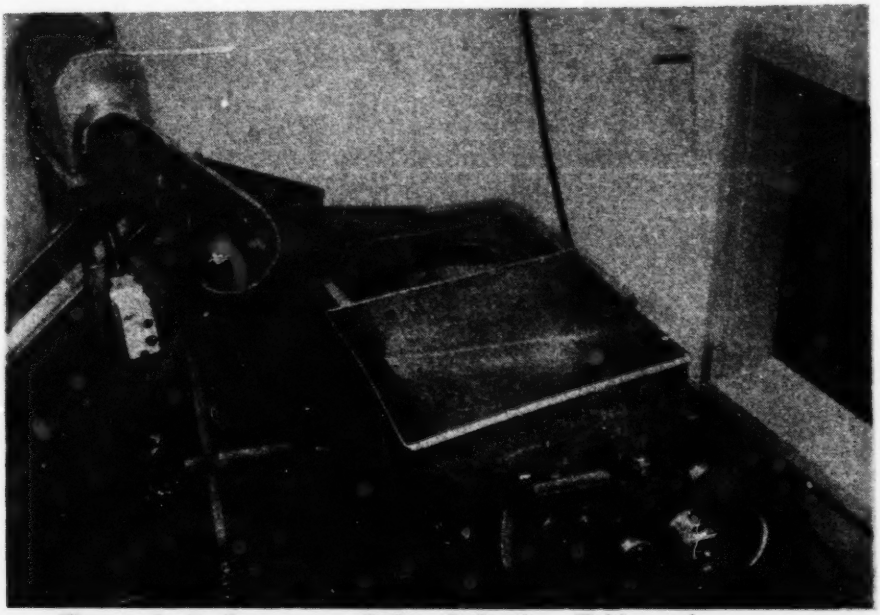


Figure 2-7 Conveyor, Collar Collection Table and BAADER 694 Mincing Machine Location

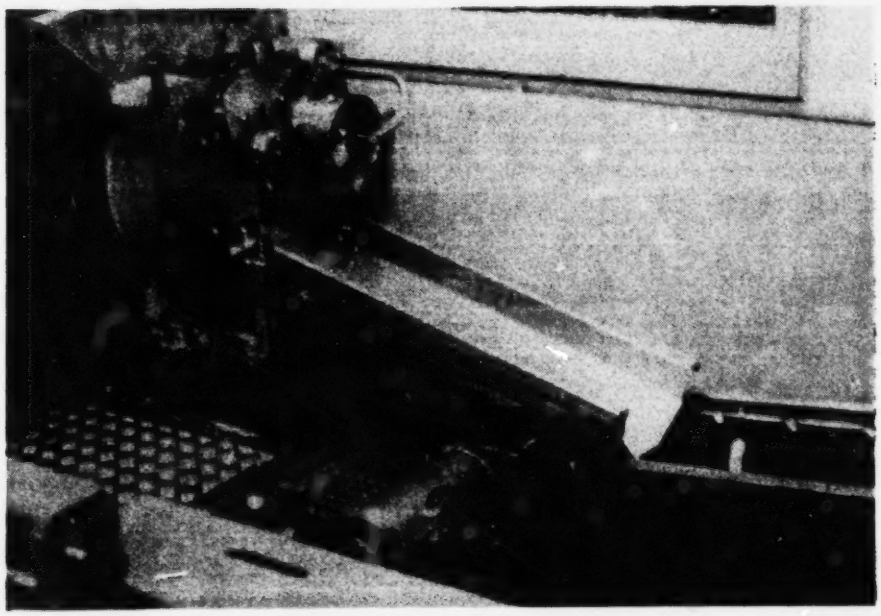


Figure 2-8 Water Sluiced Feed of Mince From BAADER 694 to Canpolar Mince Washer

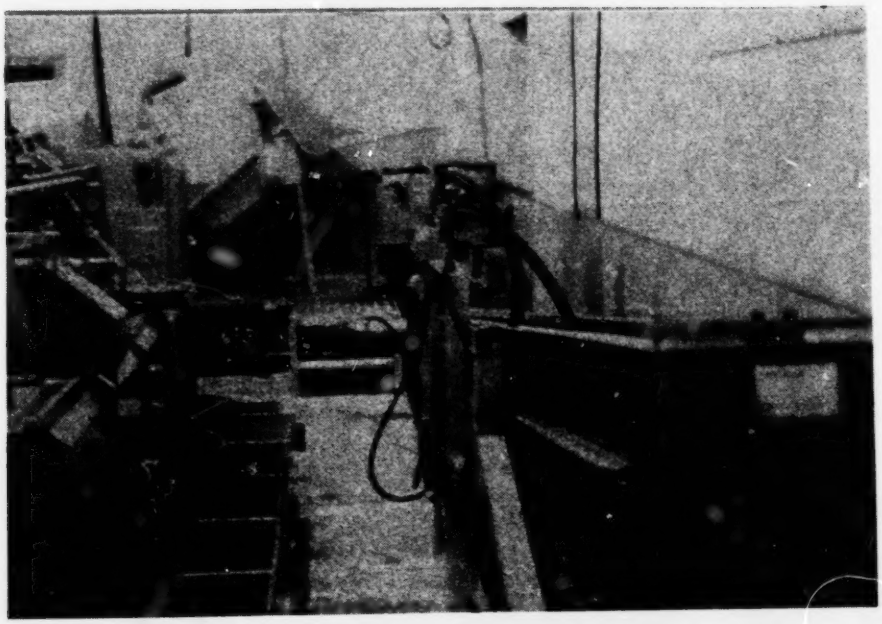


Figure 2-9 Canpolar Mince Washer and Ancillary Equipment Location at Beothic's Valleyfield Plant.

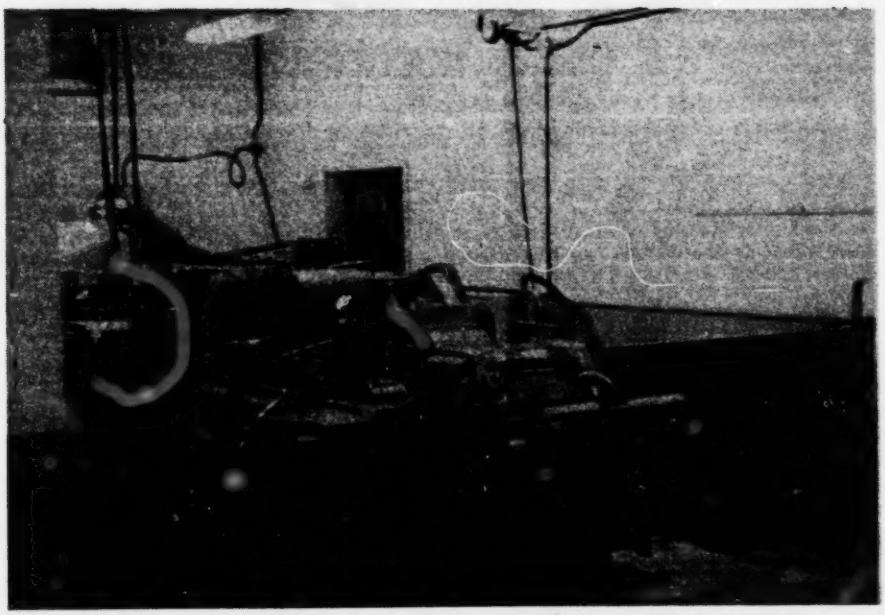


Figure 2-10 Location of BAADER 184 Filleting Machine. (Note presence of M.W. in background)

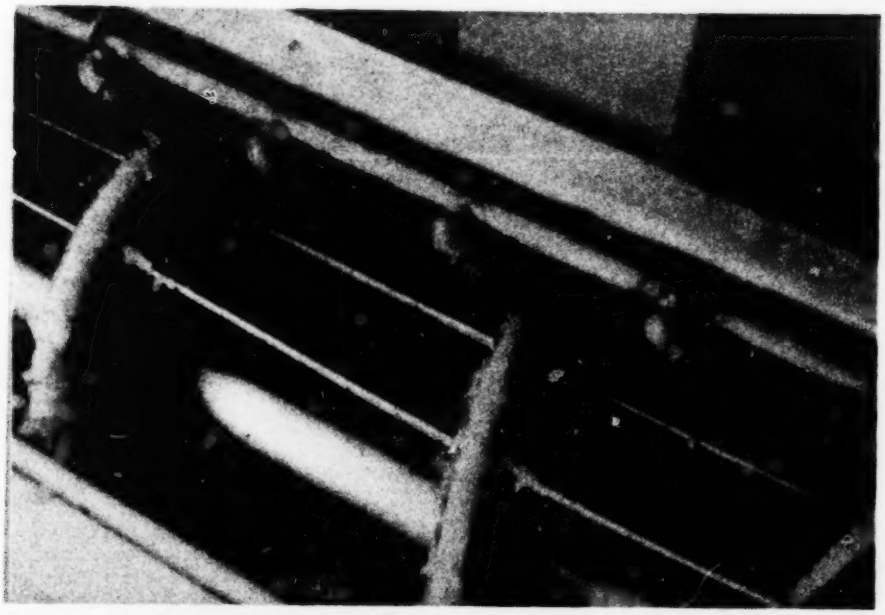


Figure 2-11 Wash Zone - Canpolar Mince Washer in Operation at Beothic's Plant

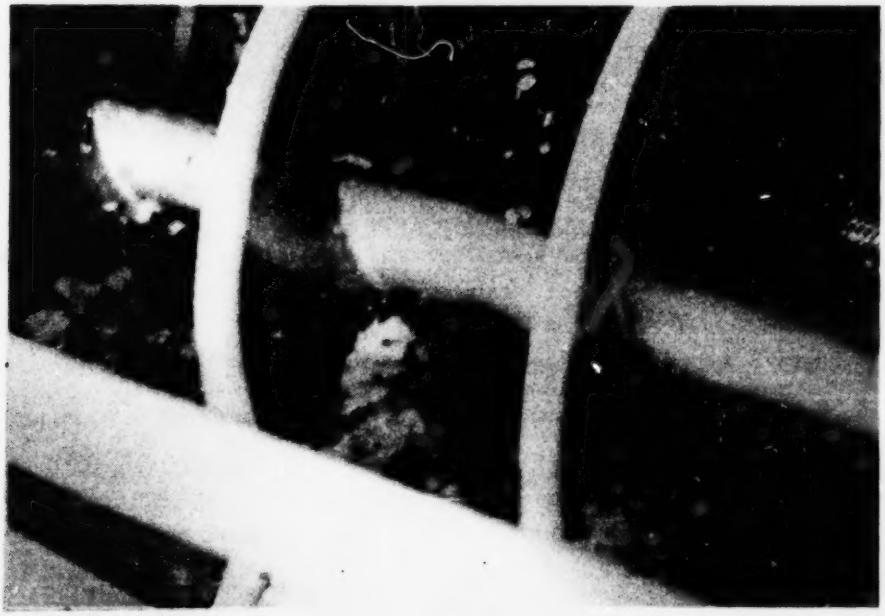


Figure 2-12 Drying Zone - Canpolar Mince Washer in Operation at Beothic's Plant

was that it was capable of operating without flooding for approximately 10 minutes. The present MINCE WASHER with the redesigned screw conveyor is now capable of being operated by an inexperienced operator for approximately one hour and with the finesse of an experienced operator the machine can run for a total eight-hour shift without causing significant problems.

The principle of operation of the MINCE WASHER is well understood and measures are being taken to re-engineer the spray nozzles to perform at an optimized low volume/high energy ratio.

Improving the spray system means that the MINCE WASHER will be capable of being operated with minimum operator intervention (without flooding) and accomodate a wider range of mince qualities and throughput.

Operational problems with the MINCE WASHER electrical speed control unit were also evident during the demonstration program. It appeared as though condensation was accumulating on the circuit boards within the speed control enclosure. When this occurred the machine operation would become erratic or else not run at all. The components specified on this machine were not meant to be extremely reliable or robust but were intended to prove the principle of operation.

The production model of the MINCE WASHER is presently being designed to appropriate specifications so as to avoid similar electrical/ mechanical breakdowns.

4.0 RAW MATERIALS

4.1 Collars

Collars represent about 8% of H.O.G. codfish weight. The collars are left attached to the cod-frame during a hand filleting operation. In most mechanical filleting operations collars either remain attached to the head upon head removal or to the fish body. This particular part of the cod is comprised of one large collar bone and solid muscle that is usually slightly darker than fillet muscle, but can be washed effectively.

4.1.1 Handling Methods

As shown in Figure 2-6, a conveyor system was installed to convey heads with collars attached to a work table for normal removal. The cod head is held in the left hand while the collars are held at the point joining to the head with a scissor-like grip of the right hand (ie. between the thumb and base of index finger). When removed the collars fall into the BAADER 694 deboner and the heads are conveyed to the meal plant via a waste trough. Collars are fed through the BAADER 694 using a 5mm pore-size drum.

The resulting mince is then fed into the MINCE WASHER. There is an existing collar bone cutter, an attachment for the BAADER 184, as mentioned in section 3.2, but it causes some quality problems when used on slightly soft fish.

A potential alternative to manual collar removal is now being studied. This system would be adopted by the BAADER 426 heading machine as a modification that will enable 100% collar removal.

4.1.2 Yield and Capacity

Using the collar removal method described above, one person can remove collars at an average rate of 215 lbs. per hour. Two persons would be required in order to remove all collars. Based on the normal throughput of a BAADER 184 line of some 40,000 lbs. per nine-hour shift, the total collar recovery amounts to 8% of the H.O.G. cod (ie. about 400 lbs./hr.). The 694 has a rated maximum capacity of 1100 lbs./hr. of raw material. During meat seperation in the BAADER 694, 64.5% of the weight of the collars is recovered as edible protein.

Yield of collar mince from the MINCE WASHER, based on weight of unwashed mince, is about 90%.

4.1.3 Labour Costs

Labour costs are cumulative throughout the production stages up to the end of washing.

The fact that collars are presently being removed manually increases labour cost slightly. Labour rates are about $8.00 per hour. Two people can remove 100% (430 lb./hr.) of collars from the BAADER 426. The cost for this operation based on yield of unwashed collar mince is 6.0 cents per pound. An automatic collar removal system, as mentioned in section 4.1.1, would eliminate this cost.

4.1.4 Quality

During the summer season, fish must be handled carefully, maintaining a constant low temperature of 2 to 5°C. Fish in this season held in storage for any more than three days begin to lose quality. Well handled cod (ie. well iced and three days old or less), produced collar mince that cleaned up effectively during the washing process.

A 5mm pore-size drum on the deboner produced mince with texture comparable to regular v-cut mince.

Some problems with mice not cleaning up normally were attributed to improper handling of the cod. Collars are located at that part of the fish where the throat is cut to permit bleeding, so some blood from bleeding diffused into the collar muscle. The longer the fish is held in storage before processing, the more difficult it is to wash out the blood.

A quality improvement system is presently being studied. This system will use high-pressure spray to reduce surface bacterial load as well as other extraneous material (ie. blood and attached specks of liver on the collars).

4.2 Trimmed Frames

The frame, or skeleton of cod that remains after filleting has some flesh on and between the bones. As with collars, this extra meat can be recovered by separation using a BAADER 694. However, the whole frames contain material that affects both the bacterial/enzymatic quality, while swim bladder membrane, belly lining, spinal cord and skin affect the visual appearance of the end product.

For these reasons, the frame is trimmed so that most of these materials are removed. As shown in Figure 2-1 and 2-2, the trimmed frame is that portion above the spinal column.

4.2.1 Handling Methods

In a hand filleting operation, trimmed frames would have to be recovered manually or by the use of a BAADER 82 bone cutter. This is not a very efficient system because of its slow speed and tedious adjustment.

In this production/demonstration project, trimmed frames were collected from the BAADER 184 processing line by the use of a frame cutter attachment. The mechanical attachment removes the portion of the frame on the dorsal side of the spine as shown in Figure 2-1 and 2-2 , by the use of a single horizontally rotating circular blade. The frame cutter requires minimum monitoring by the operator to avoid blockage, mainly when processing slightly soft fish.

The trimmed frames were collected in 150 lb. tote pans, then fed into the BAADER 694 deboner. This process involves no delay, and as a result storage is eliminated and spoilage is minimized.

4.2.2 Yield and Capacity

The frame cutter attachment of the BAADER 184 was capable of producing about 140 lbs. of trimmed frames per hour in regular continuous operation. This portion amounts to about 30% of the whole frame. The remaining 25-30% of usable frame material is on the ventral side of the spinal column and cannot be automatically recovered (see Figure 2-1). The portion of the frame that is recovered yields about 39.5% mince recovery, based on trimmed frame weight.

4.2.3 Labour Costs

There are no labour costs involved in actual trimmed frame recovery because of the use of an automatic frame trimmer on the BAADER 184. Trimmed frames are produced at a rate of 140 lbs. per hour and 40% yield of unwashed mince is obtained. Total unwashed mince amounts to 326 pounds. It is appropriate in this calculation to include one person to carry trimmed frames to the deboner as well as feed and monitor the 694 deboner. Overall, three workers are involved in production of mince from trimmed frames, resulting in a labour cost of 7.4 cents per pound of unwashed mince.

4.2.4 Quality

Quality of trimmed frames, as with collars, depends on the handling and quality of the fish. Good quality trimmed frames are white with very little if any trace of blood throughout the flesh. The odor will be characteristic of cod. Mince from this material will also be fairly white.

As explained in section 4.2, trimming of the frame eliminates most extraneous material (i.e. skin, membrane, etc.). However, the mince from trimmed frames contained trace amounts of spinal cord and black skin specks. The presence of spinal cord indicated that the frame cutter attachment of the 184 was not removing the spinal cord column from all frames. This was due to irregular size of fish. The skin specks in the mince came from the dorsal fins attached to the trimmed frames. The method used for removing these extraneous materials is discussed in Section 5.4.

4.3 Optimum Raw Material

Sections 4.1 and 4.2 have discussed some of the factors associated with the quality of raw materials, i.e. collars and trimmed frames, and how these materials affect mince quality of raw material and of unwashed mince. A Colormet was used for more objective results.

Colormet is a hand-held electronic/optical device that provides a quantifiable measure of color which is unaffected by the conditions that limit the human eye. Two models of the Colormet were used in this project.

The Colormet initially used was designed for measurement of blood content in fish flesh. Measurements were taken on unwashed and washed mince which indicated the effect of washing on blood removal, and indirectly, the whiteness. Results of these measurements are in Appendix C. These results are discussed in section 5.1.4.

It was decided, based on information from processors, that whiteness was a more important quality factor. To directly measure the whiteness, another model of the Colormet was used; one that measures color "value" on the "L, a, b" scale. The results of these measurements are also in Appendix C and are discussed in section 5.1.4.

In a glut season when cod feed heavily on capelin, their muscle tissue is softer and, once harvested, they tend to deteriorate more rapidly. Soft fish produces poorer quality mince. The best quality mince is produced from the optimum raw material recovered from Grade A fish, that is fresh, well bled, well iced and not more than three days old. The fish must be thoroughly gutted so there are no specks of liver or other gut material attached to the collars which would get into mince during deboning. Frames must also be trimmed so as to minimize the amount of extraneous material in the mince.

5.0 END PRODUCT

5.1 Washed Mince

In a normal production situation, collars and trimmed frames would be processed together. For a single BAADER 184 line, the ratio of collar mince to frame mince in total washed mince volume is 80:20.

5.1.1 Handling Methods

During production, unwashed mince was fed into the MINCE WASHER at a rate of about six lbs. per minute.

Washed mince approached the drying section where excess moisture drained and then fell into a perforated pan to allow additional drainage. The next production step was mixing the washed mince with v-cut mince. This was done manually at weighing point where the washed mince added to v-cut mince at Beothic's plant was about 25/75. Thorough mixing of washed and v-cut mince was essential for a uniform product appearance. A preferred method for mixing would be during the refining process which is discussed in Section 5.2.

5.1.2 Yield

Although collars and trimmed frames might be processed together in a normal production situation, each was processed separately to determine yields from the washing process. In the wash process, the yield for collar mince was 90%. Most loss here was due to leaching of sarcoplasmic proteins and natural salts.

A slightly lower yield of 78% was obtained when washing trimmed frame mince. Muscle fiber bundles on cod frames are shorter than those in intact fillets or collars. The bundles separate easily into fine particles and some escape with wash water.

When collars and trimmed frame mince were processed together, less loss was incurred from the frame mince. This is because the larger particles of mince from collars act as a primary filter to retain the finer particles.

5.1.3 Labour Costs

As noted in Section 4.2.3, three persons are required to feed collars and trimmed frames to the BAADER 694 and to operate the system. A fourth person is needed to feed and monitor the MINCE WASHER. Based on this and 90% yield from the washing process, the labour cost for

production of washed mince prior to packing is 10.9 cents per lb. of washed mince.

5.1.4 Quality

Color is the most important factor in determining the quality of mince. Other factors include odor, texture and extraneous material such as bones, membrane and skin specks. Color is usually judged on a sensory basis, as described in section 4.3.

Appendix C, Table C-1 lists the average blood content readings for 100% v-cut mince; collar mince, unwashed and washed; trimmed frame mince, unwashed and washed and mixtures of washed and v-cut mince as determined by Colormet readings.

The difference in unwashed and washed blood content of both collar and trimmed frame mince clearly indicates that washing is effective. In fact, washing brings the "blood content" of trimmed frame mince down to a Colormet reading of 29, compared to an average of 35 for v-cut mince. Washed collar mince has a "blood content" of 36. Mixed collar and trimmed frame mince gave readings of 31. "Blood content" or "Hb value" as determined by Colormet does not necessarily reflect the actual appearance or "whiteness" of the mince. The apparent "whiteness" is better reflected by the "L,a,b" color values of the mince.

Appendix C, Table C-2 (parts a and b), show "L,a,b" readings from frozen, thawed and cooked mince at various mixtures. The sample code for these mixtures and treatments is described in Appendix B, Table B.

Color is measured in three components: "L", "a" and "b" which are respectively whiteness, reed-green and blue-yellow. The whiteness reading is most important. Higher numbers indicated lighter color. Table C-2 (part b), contains the data for the final highest quality product produced. The "L" value differs only very slightly from that of sample P, the control (100% v-cut). Sample M(25/75) value is closest to the control value, indicating no color change by adding washed mince.

The other important quality control parameters were bone content and skin pieces or "specks" in the mince. Samples produced during July and August showed evidence of skin and bone content (See Table C-2). The processing methods were then modified to solve this problem. The production in September (sample blocks M, N, O, P) was much better. There were no incidences of bones and very few incidences of skin specks of significant size (6mm) in these samples. The blocks were also free of parasites, which is a major concern of all processors.

No problems were experienced with the odor or the texture of washed mince.

5.2 Refining

To further improve the quality of washed mince, a refining step was added to the process. For this demonstration project, a BAADER 694, with a 3mm poresize drum was used for refining. At a low tension setting, the deboner effectively removed a large percentage of bones, membrane and skin specks from washed mince.

For improved quality of regular v-cut mince, it was suggested that v-cut mince should be run through this refining stage, while at the same time washed mince would be added. Refining and mixing could be done in one step.

5.3 Mixing Washed Mince with V-cut Mince

Various mixture ratios of washed and v-cut mince were initially tested, mainly for color. Mixtures with 50% washed mince were slightly darker than the normal acceptability level. Mixtures with 50% washed mince in the frozen block were sent to test markets for analysis. The most acceptable and still reasonable ratio was the 25/75 mix (washed/v-cut). Analysis results from Mrs. Paul's Kitchen indicated that the mixture is directly comparable in quality to 100% v-cut mince. See Appendix D, Mrs. Paul's Kitchen.

5.4 Optimum End Product

Based on test market results, an optimum end product would be block with washed mince added to v-cut mince to a maximum of 25%. The mixture could be passed through a 3mm refiner to ensure bones, membrane and skin removal, as well as mixing, all in one process. When frozen in block form, this material can be used in the same manner as 100% v-cut mince without any noticeable sensory difference.

6.0 END PRODUCT MARKET RESULTS

There are various uses envisaged for washed mince in the secondary and tertiary processing industry; the more easily accessible markets being surimi, salt-mince products, and portions from mince block.

All three were investigated. However, at the time of this project, the one surimi plant in Canada, Terra-Nova Fisheries in Clarenville, Newfoundland, had a full supply of whole cod for surimi production due to the cod glut situation and was unable to handle any washed mince. Further, the secondary salt fish products plant, Green's Fisheries in Winterton, Newfoundland, was temporarily closed down. For this reason the project focus was on the production of mince for use in block. The Gorton Group in Gloucester, MA and Mrs. Paul's Kitchen in Philadelphia, PA are secondary processors of mince block. Fishery Products International and National Sea Products are both primary and secondary processors. These companies were open for ways of increasing volume of available minced fish.

The chosen course of action was to send samples to these and other companies and get their feedback after a lab analysis. Mince blocks of Samples F and G (See Table B, Appendix B) were sent to Fishery Products International and National Sea Products. Canpolar has not received to date any results of analysis from Fishery Products International. National Sea indicated that the overall workmanship of the product was satisfactory for use in secondary processing (See Appendix B - it may be noted that the reference to off-odour is attributable to delay in packing the samples).

Final sets of sample blocks; M, N, O, P (See Table B, Appendix B) were sent to Gortons and Mrs. Paul's Kitchen. Gortons indicated a positive interest and suggested production changes that would improve the mince to meet their specifications (See Appendix D). Mrs. Paul's Kitchen gave positive response, indicating acceptability of the mix ratio 25:75 (washed: v-cut) as a usable raw material in their product line.

7.0 MINCE PRODUCTION ECONOMICS (Paybacks)

This project has demonstrated that the Canpolar MINCE WASHER can be integrated into a modern fish plant quite easily. Only about 100 ft.^{2} of floor space is required and the necessary ancillary equipment required is available in most plants. The Mince Washing technology is capable of increasing the total plant output by as much as 13%, though the recovery of collar bones and trimmed frames. Based on yields, throughputs, labour, and nominal product values established in the course of this study, a payback calculation has been made for a minimum and maximum scenario (Table 6.1, p.26).

The common assumptions are:

1. The total cost of equipment is about $137,000 including MINCE WASHER BAADER 694 deboner, conveyors and an ancillary deboner for use as a refiner.

2. The value of washed mince is $0.60/lb.

3. Labour costs are based on $8.00/hr. wage.

4. The costs of packaging, brokerage, labour, etc., total about $0.25/lb.

For the first scenario the throughput is limited by the 560 lb. output of collars and trimmed frames from a single 184 production line. In this case the net revenues of $0.35/lb. for washed mince result in equipment payback over about 160 shifts or six million lbs. production.

For the second scenario, the throughput is limited by the input capacity of the 694 deboner (ie. about 1,100 lbs./hr.). The deboner yield of about 600 lbs./hr. is also the limiting capacity for the MINCE WASHER. In this case, the payback is about 80 shifts assuming six million lbs. is produced during that period.

If the maximum capacity (1,100 lb./hr.) of the BAADER 694 is maintained, then the payback is reduced to 82 shifts which could be 41 days during peak production. Labour costs for the minimum payback scenario include seven (7) people for eight hours at $8.00 per hour. Also the cost of equipment is slightly increased due to the addition of extra collar table and fluming.

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TABLE 6.1

	Maximum Payback (BAADER 184 Capacity)		Minimum Payback (BAADER 694 Capacity)
Payback Calculations			
Volume of H-O-G cod required to payback additional equipment costs in one year is	6,309,280		6,253,812
At production per 8-hour shift of	39,433		76,266
Equal number of shifts	160		82
Production Volume			
Incremental volume to bone separator			
Trimmed Frames 2.6% H.O.G.	164,041		718,835
Collars 8.6% H.O.G.	542,598		
Incremental Minced Volume	414,771		416,924
Incremental Production from Canpolar MINCE WASHER: (90% yield) 6.0% H.O.G.	373,294		375,232
Value of Incremental Production			
Sales Value:	$ 223,977		$ 225,139
Less: Packaging Material	(9,332)		(9,381)
Freight 6¢/lb.	(22,398)		(22,514)
Brokerage (5%)	(11,199)		(11,257)
Electricity 2¢/lb.	(7,466)		(7,504)
Water 2¢/lb.	(747)		(750)
Labour 4 persons	(40,960)	7 persons	(36,736)
Net value of incremental production	$ 131,875		$ 136,996
Equipment Costs (Incremental)			
Canpolar MINCE WASHER	$ 65,000		$ 65,000
Prewash Deboner (BAADER 694)	31,000		31,000
Post Wash Refiner (BAADER 694)	31,000		31,000
Conveyors/Collar Table/Fluming	6,700		10,000
Total Equipment Costs	$ 133,700		$ 137,000

9.0 CONCLUSIONS

Results of this project indicated that, with existing technology, the MINCE WASHER system paybacks could be realized in a maximum of 160 shifts by utilizing raw material from the BAADER 184 line, and a minimum of 82 shifts by utilizing extra raw material from other machine filleting operations as well as hand cutting operations.

10.0 EPILOGUE

Improved frame trimming technology could increase the existing frame mince recovery by as much as 50%. Within the next 1-2 years, BAADER will introduce a modified collar removal system that will greatly reduce labour cost by replacing two people for collar removal, thus increasing net profit from washed mince and reducing MINCE WASHER payback time.

A meeting was held between Canpolar and Beothic Fish Processors after the termination of the production/demonstration project. The objectives of this meeting were to present the project result from a technical and from a market viewpoint. Beothic indicated that they were pleased with the positive feedback from U.S. secondary processors, but they would require more market feedback based on a full production situation. This would mean producing two or three 10,000 pound lots of product, sending it through the regular channels of secondary production and obtaining positive results.

These conditions being met, Beothic would be prepared to purchase such a system.

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